

Epidemiology of unnatural death from suspected poisoning: an autopsy based study

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Abstract:

Background: Increasing trend of poisoning leading to unnatural premature death in man restraints development of a country. Epidemiology of poisoning can help stakeholders to take measures for prevention of poisoning.

Objective: to assess the magnitude of unnatural death due to suspected poisoning and to find out its correlates.

Methodology: Record based cross-sectional study was performed in the department of Forensic Medicine of Bankura Sammilani Medical College involving the victims of unnatural death due to suspected poisoning during year 2014. Information pertaining to sociodemographics, place and time of occurrence of poisoning and death after poisoning, background cause of poisoning etc. was collected from the postmortem report, police inquest and treatment history, if any using a predesigned proforma.

Results: Overall, 11.12% of unnatural death was due to suspected poisoning. Although in case of poisoning male proportion was higher (57.55%) overall proportional mortality attributed to poisoning was higher in female (13.19% vs 9.96%). Average age was 37.55±16.13 years with highest death in 40-49 years age interval. Around 94.0% cases happened within premises, around 2/3rd cases during day and mostly ascribed to depression (48.2%) and domestic conflicts (36.69%). Majority of poisoning cases happened during winter (35.0%). Care could be sought in higher number of cases where occurrence took place within premises (87.69%) and in morning (92.16%). Illness was associated with higher age for committing poisoning.

Conclusion: Counseling in different life situations and strict legal enforcement in selling and handling of agrochemicals is the need of the hour to avoid premature loss of human resource from unnatural deaths due to poisoning.

Key-words: unnatural death, suspected poisoning, domestic conflict, seasonal variation

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I. Introduction

Rapid development in science and technology and fast growth in agriculture and industrial sector have led to increasing trend in the incidence of poisoning leading to unnatural premature death of lot of precious human lives and thereby hampering human resource development of any country.¹ Poison is a substance that causes damage or injury to the body and endangers one's life due to its exposure by means of ingestion, inhalation, or contact.²

Globally, intentional poisoning is one of the important causes for morbidity and mortality.³ Various agents such as agrochemicals, drugs or environmental substances are used as poisoning agents.⁴ Distress due to failure to achieve, loss in the business, refused in love/failure in romance or conflict with the intimate partner/near or dear ones, or failure in examination, emotional disturbances and frustration of chronic diseases are the common reasons for intentional poisoning.⁵ However, accidental poisoning also is on rise.⁶

According to WHO 3 million acute poisoning cases with 2, 20,000 deaths occur annually. Of these, 90 % of poisoning occurs in developing countries.⁷ Acute pesticide poisoning is one of the most common causes of

intentional deaths throughout the globe.⁸ In industrialized countries high doses of analgesics, tranquillizers, and antidepressants are the commonly used agents for intentional poisoning⁹ and agrochemical, specially the agriculture pesticides are more commonly used in Asian region for self poisoning particularly in rural areas with a fatality range of 10-20%.¹⁰ More incidence of pesticide exposure is seen in middle and low income countries due to increased use of agrochemicals in agricultural sector.¹¹

Many studies have reported that ingestion of pesticides is the commonly used mode of intentional poisoning in India.¹² As agriculture is major profession in the rural part of India farmers stock the pesticides for its repeat use to eliminate the weeds and pests. It is due to their easy availability the pesticides are commonly used by the emotionally overwhelmed individuals to end their life in different stressful life situations.¹³

The autopsy in a suspected case of poisoning can be one of the most challenging problems faced by a forensic pathologist, not in technical procedure of the examination but in the final evaluation from all the available information. Considerable proportion of those died from suspected poisoning would have died in hospitals and it is of prime importance that the medical records be obtained and studied before the autopsy begins.¹⁴

Bankura is a 'rarha' district in the South-Western part of the state West Bengal, India where most of the people live in rural areas and engaged in agriculture as the major occupation. Bankura Sammilani Medical College (BSMC) is one of the peripheral medical colleges of West Bengal catering the people of whole Bankura district and part of the adjacent districts like Bardhaman, Purulia for the purpose of health care as well as postmortem (PM) examination. On this background, the present study was carried out with the following objectives.

Objectives:

1. To estimate the magnitude of suspected poisoning among all unnatural deaths brought for PM examination in the mortuary of BSMC
2. To find out the sociodemographics of the deceased of suspected poisoning
3. To assess other correlates of death due to poisoning, if any.

II. Methods and Materials

The present research was a descriptive cross-sectional study undertaken at the mortuary of Bankura Sammilani Medical College and Hospital (BSMC&H), Bankura, India during the period, January to December 2014. All the cases of unnatural deaths due to suspected poisoning occurred in course of treatment at BSMC&H and subjected to medico-legal autopsy during the study period were included in this study. The study also considered all unnatural deaths due to suspected poisoning from the adjacent districts like Bardhaman, Purulia brought to the mortuary of BSMC for the purpose medicolegal autopsy. However, unknown, severely decomposed and exhumed bodies were not considered. After obtaining necessary approval of the Ethical Committee 2ndary data were gathered retrospectively from the postmortem report, police inquests, copy of death certificates of each deceased using a predesigned format.

Data were analysed using M S Excel and SPSS-16 free version. Various statistical methods like charts, tables etc. were used for data display. Results were described by mean, standard deviation, proportion etc. and independent 't' test, chi-square test, median test, Mann-Whitney U test, Odds ratio (OR) with its 95 percent confidence interval (CI) etc. were used to explore association between variables. P value of ≤ 0.05 at 5% precision was considered significant.

Operational definition: For this study some definitions were adopted:

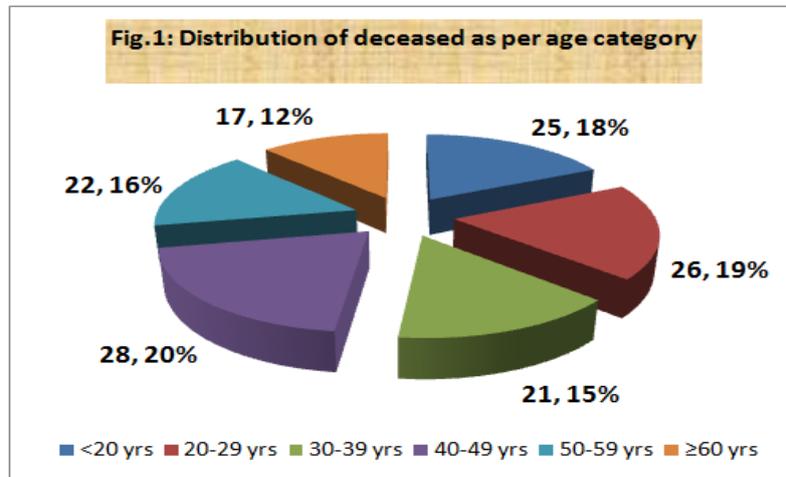
- 'Suicide'- death due to self harm to end one's life.¹⁵
- Suspected poisoning mean, findings during inquest history, and gross autopsy are only suggestive but there is no confirmatory test.¹
- 'Accident'-death due to negligence by the person himself or by others without any criminal intention or from any natural disastrous event.¹⁵
- Timing of poisoning-
 - ❖ Midnight & early morning= from 12 night up to 6:00am
 - ❖ Morning=from 6:00am up to 12 noon
 - ❖ Afternoon & evening=from 12 noon to 6:00pm
 - ❖ Night= after 6:00pm to 12 night.

III. Results

Altogether there were 1250 PM examinations done during the study period with 803 i.e. 64.24% male and the rest (447 i.e. 35.76%) female. The male: female was 1.79:1. Out of the total unnatural deaths 139 i.e. 11.12% were found to be the result of suspected poisoning. Out of the 139 deaths due to poisoning 80 i.e.

57.55% were male with M: F=1.36:1. On the whole the proportional unnatural mortality due to poisoning was estimated to be about $80/803 \times 100 = 9.96\%$ for male and $59/447 \times 100 = 13.19\%$ for female that meant more female unnatural deaths were caused due to poisoning. However, the difference between two proportions was not statistically robust enough to draw any inference in favour of positive association between gender and unnatural deaths caused by poisoning [$\chi^2 = 3.04$ at df 1, $p = 0.081$ (OR=0.73 with 95% CI of 0.50-1.06)].

On the whole the average age was estimated to be 37.55 ± 16.13 (mean \pm sd) years with median 38.0 years and range of 82.50 years. The mean age of female [mean \pm sd= 33.34 ± 17.11 vs 40.66 ± 14.71] was significantly lower (unpaired $t = 2.703$ at df 137 with $p = 0.008$).

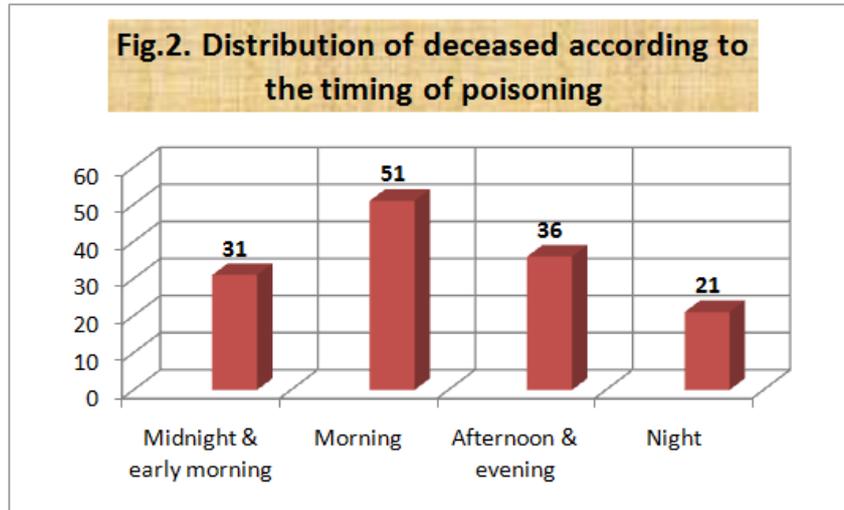


Majority (20.0%) cases belonged to the age group of 40-49 years closely followed by the age group 20-29 years which contributed 19.0% of the total cases of unnatural deaths from poisoning. Both adolescent [except one accidental case of 1.5 yrs] and senior person (≥ 60 yrs) contributed 30.0% of cases. [Fig.1] It was only the adolescent group where the proportion of female deceased was found to be higher. The figures for male and female were 32.0% vs 68.0%, 50.0% vs 50.0%, 61.9% vs 31.1%, 71.43% vs 28.57, 68.18% vs 31.82% and 64.71 vs 35.29% for the age groups of <20 yrs, 20-29 yrs, 30-39 yrs, 40-49 yrs, 50-59 yrs and 60 yrs and above, respectively. There was a decreasing trend in unnatural death with increasing age after the peak in the age group of 40-49 yrs. Almost 93% of cases of unnatural death from suspected poisoning belonged to the district of Bankura, around 98% were rural residents and 98.56% were Hindu by religion.

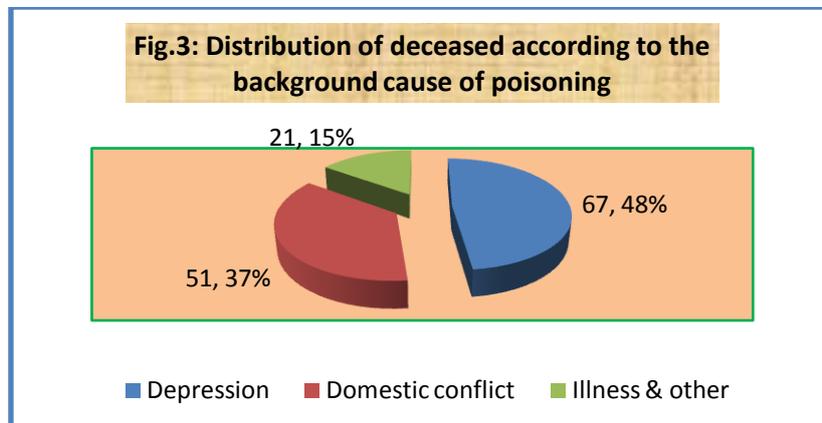
So far as the caste was concerned, about two-third (64.03%) belonged to the general caste and the rest were from backward classes. Further analysis showed that the caste was not shown to vary across the gender [$\chi^2 = 0.404$ at df 1, $p = 0.525$].

It was revealed from analysis that 75.54% of the deceased was married and though the proportion of married male was higher but marital status was found not to vary (78.8% vs 71.2%) significantly across the gender [$\chi^2 = 1.05$ at df 1, $p = 0.305$].

Regarding the place of occurrence of the event of poisoning, it was reflected from analysis that in 93.53% of cases the event of poisoning was happened to take place within the residential premises. In this regard, no statistically significant gender difference was observed ($\chi^2 = 1.611$ at df 1, $p = 0.204$), though the proportion of event happened outside of home was higher among the male (77.78%).

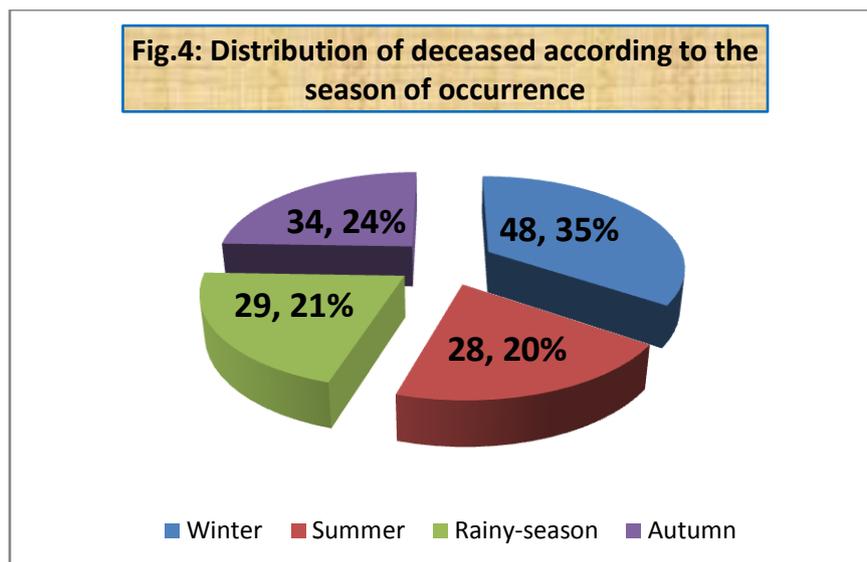


Around two-third (62.59%) of poisoning was found to take place in day time and out of that majority (58.62%) of event was happened in the morning time (between 6:00am to 12 noon). However, a substantial portion of event (37.41%) occurred in such time slots when the event could rarely be noticeable. [Fig.2.]



The background event led to the poisoning was assessed based on the police inquest report. It was revealed that majority (48.20%) of the deceased was found to be a victim of depression might be of any duration. More than one third i.e. 36.69% was result of domestic conflict/violence/marital disharmony/quarrel etc., However, around one seventh (15.11%) cases reported to seek poisoning out of the frustration/agonny of physical and or mental disease.

Apart from one accidental poisoning in a 1.5 years old male child there was no case where any sort of foul play indicating towards homicide could be observed in post-mortem report. However, many cases were still sub judice and thereby couldn't be categorised as suicidal. They could be classified as "suspected poisoning" cases.



Analysis further revealed that majority of cases took place during late Winter including early Spring closely followed by Autumn when maximum use of agrochemicals, specially pesticides are usually used during cultivation of ‘rabcrop’ in late Winter & early Spring and ‘Aman’ paddy during Autumn in this area of West Bengal. In 117 i.e. 84.17% of deceased death was happened after admission in the hospital and rest were brought dead. In this respect no statistically significant difference could be explored between age categories, gender, marital status and background causes. [Table-1] However, difference was explored between place of occurrence and timing of poisoning with higher proportion of brought dead in cases where the events happened outside the home and poisoning took place during midnight including early morning. (Table-1)

Table-1: Distribution of deceased as per their treatment status after poisoning and few attributes.

Attribute		Hospitalised No. (%)	Brought dead No. (%)	Omnibus df, p	χ^2 , df, p	OR (95%CI)
Agecategory	Up to 19 yrs.	22(88.0)	3(12.0)	2.097,3,0.552	NA	NA
	20-39 years	47(81.03)	11(18.97)		NA	NA
	40-59 years	32(82.05)	7(17.95)		NA	NA
	≥60 years	16(94.12)	1(5.88)		NA	NA
Gender	Male	68(85.0)	12(15.0)	NA	0.097,1,0.756	1.156(0.463-2.890)
	Female	49(83.05)	10(16.95)			
Marital status	Married	87(82.85)	18(17.15)	NA	0.558,1,0.455	0.644(0.202-2.056)
	Unmarried	30(88.24)	4(11.76)			
Place of occurrence	Within premises	114(87.69)	16(12.31)	NA	18.670,1,0.000	0.070(0.016-0.309)
	Outside	3(16.67)	6(15.0)			
Timing of poisoning	Midnight & early morning	21(67.74)	10(32.26)	9.487,3,0.023	*	*
	Morning	47(92.16)	4(7.84)		8.12,1,0.004	0.18(0.04-0.72)
	Afternoon & evening	32(88.89)	4(11.11)		4.51,1,0.033	0.26(0.06-1.08)
	Night	17(80.95)	4(19.05)		1.11,1,0.291	0.49(0.11-2.17)
Background cause	Depression	58(86.57)	9(13.43)	0.579,2,0.749	NA	NA
	Domestic conflict	42(82.35)	9(17.65)		NA	NA
	Illness & other	17(80.95)	4(19.05)		NA	NA

*reference group

Table-2: Distribution of deceased according to the duration they survived after hospitalisation and few attributes

Attributes		>Median No. (%)	≤Median No. (%)	χ^2 ,df,p
Age category	Up to 19 years	12(48.0)	13(52.0)	0.014, 3, 1.000
	20-39 years	28(48.28)	30(51.72)	
	40-59 years	19(48.72)	20(51.28)	
	≥60 years	8(47.06)	9(52.94)	
Background cause	Depression	31(46.27)	36(53.73)	0.261, 2,
	Domestic conflicts	25(49.02)	26(50.98)	

	Illness & others	11(52.38)	10(41.62)	0.878
Time category	Midnight & early morning	10(32.26)	21(67.74)	7.048, 3, 0.070
	Morning	23(45.09)	28(54.91)	
	Afternoon & evening	23(63.89)	13(36.11)	
	Night	11(52.38)	10(47.62)	

Median=6

So far as the duration the deceased survived after hospitalization (assuming 0 hrs for those who died on the spot or on the way and brought dead to the hospital) no statistically significant difference was revealed in respect of age category, time of occurrence, background cause, gender, marital status [Table-2 & 3]. However, statistically significant difference could be found out across the place of occurrence of poisoning. The deceased committed poisoning outside the premises was found to survive lower duration than that of the victims who committed poisoning within premises. [Table-3]

Table-3: Distribution of deceased as per hours they survived after hospitalisation and few attributes

Attributes		Mean rank	Mann-Whitney U	Z,p
Gender	Male	70.65	23.08	0.223,0.824
	Female	69.12		
Marital status	Married	68.51	16.29	0.768,0.443
	Unmarried	74.59		
Place of occurrence	Within premises	72	317.00	2.304,0.021
	Outside home	40		

Table-4: Distribution of study subjects according to the age and background cause of poisoning.

Background cause	Age	F(ANOVA),df,p	P as per post-hoc test	95% CI of mean differences
	(mean±sd)			
Depression	39.28±15.79	5.833,2,0.004	0.047	0.0641-14.111
Domestic conflicts	32.19±15.17		*	NA
Illness & other	45.02±15.93		0.006	-22.63 to 3.03
Total	37.55±16.13		-----	-----

*reference group

Analysis also revealed that the age of the deceased was found to vary across the background causes of poisoning. Age was estimated to be significantly higher in the group committed poisoning out of physical/mental illness compared to their counterparts. Age was found to be the lowest among the victims committed poisoning due to domestic conflicts/violence.

IV. Discussion

In the present study the proportion of death due to suspected poisoning was estimated to be 11.12 percent with concurrence to the observation of 8.79 percent made by Kumar A et al. in their study conducted at Varanasi.¹ A study from Rohtak, Haryana too reported 26.6% of all medicolegal deaths to be due to poisoning.¹⁶ However, a study conducted by Fedakar R et al. in South Marmara Region of Turkey revealed that the proportion of poisoning case was 9.8%.¹⁷

Kumar A et al. reported higher death rate of 60% in 20-40 years compared to 42% of this study.¹ Batra A K et al. in their study carried out at Shri Vasant Rao Naik Government Medical College, Yavatmal, Maharashtra observed 53.4% death in this age group with the highest (28.4%) in 21-30 years age interval compared to the highest (20.0%) in 40-49 yrs age group revealed by the present study.¹⁸ McDowell R et al. found in their study in New Zealand that largest number of cases was found in the age group of 25-44 years.¹⁹ However, Kumar A et al. reported from their study conducted at Varanasi that maximum (45.10%) in the age interval of 21-30 years.²⁰ Again, Naveen N et al. observed that most commonly (31.98%) affected age group was 21-30 years.²¹ Similarly, Maharani B et al. found that peak (31.33%) was in the age range of 21-30 years.²² Jesslin J et al. conducted a retrospective prospective study at Mysore with all poisoning cases attended to the JSS Medical college hospital and observed that majority of the poisoning incidences were seen in age group between 18-29 years.²³

This difference in the proportion might be due to geographical variation in the population. Jesslin J et al. also noted that the incidence of poisoning decreased with the increasing age which had concurrence with the present study.²³

The age as estimated in this study was 37.55±16.13 (mean±sd) years and it is close to what was estimated by Fedakar R et al. i.e. the mean age of 40 ±19.2 years.¹⁷

Batra AK et al. observed that 67% of deceased from unnatural deaths due to poisoning were males.¹⁸ Fedakar R et al. revealed that 73.2% of poisoning case was male.¹⁷ Male predominance was also reported by other investigators viz- McDowell R et al.(68.9%), Kumar A et al. (71.54%), Maharani B et al.(61.33%).^{19,20,22} Jesslin J et al. showed that amongst the intentional poisoning cases, adult males (60.2%) predominated over

adult females (39.8%).²³ However, Naveen N et al. observed that majority (55.60%) were female.²¹ Overall proportional mortality of poisoning as estimated in this study was higher in female (13.19% vs 9.96%).

Higher male death preponderance might be attributed to the reason that males were more exposed to stress and strain associated with monsoon dependent cultivation practice and also to other occupational hazards. However, female dominance in adolescent group as revealed in the present study was found to have similarity with the observation made by Jesslin J et al. who reported that in adolescence group majority of poisoning was seen in females (71.4%) when compared to males (28.6%) with sex ratio of 1:1.4.²³

Batra AK et al. observed that 63% victims were married compared to 75.54% of the present study.¹⁸ Maharani B et al. also found that 67.33% deceased were married.²² Naveen N reported 53.41% of the victims to be married.²¹ Kumar A et al. reported from their study that among the poisoning cases where marital status could be explored 21.65% were found to be married out of that 0% was male and 100% was female.²⁰

Batra A K et al. reported that 83% were rural residents and 63.4% were suicide. The corresponding figures revealed in present study were 98% and 98.28%, respectively.¹⁸

Almost all the cases of unnatural deaths from poisoning found to belong to the rural areas might be due to the fact that agrochemicals, specially the pesticides are the commonest agent very easily available for committing self ending endeavour as most of the rural residents are engaged in agricultural activity.

Maharani B et al. showed in their study at Tamil Nadu that all cases of unnatural deaths were due to oral consumption of poison, 98.67% was intentional and rest was due to accidental which has concurrence with the present study with 99% cases were suspected poisoning and about 1.0% was caused by accidental poisoning.²²

Maharani B et al. also found that 98% of the deceased were Hindu.²² As per Kumar A et al. the Hindu outnumbered the Muslim.²⁰ Findings of both of these studies have concurrence with the observation of the present study. Maharani B et al. also noted that in majority (80%) of cases the event of poisoning occurred in day time which is in concurrence with the present study revealing the proportion to be around two-third (62.59%).²²

It was clear from the analysis that most of the cases of poisoning including the accidental one could be prevented as about two-third of them was committed during day time and majority of them were happened within the residential premises. All these mishaps would be noticeable if the family members could apprehend.

Maharani B et al. found that more cases were found in (36%) Summer.²² Jesslin J et al. also reported that majority poisoning cases were seen during the summer season (28.1%) followed by the winter season (26%).²³ These observations are in contrast to the finding of this study where maximum cases of unnatural death due to poisoning was found to take place in Winter. This was revealed from the present study that almost all cases (98%) were rural residents which was also corroborated to the figure that the majority of the cases took place during the cultivating period of the crops which requires higher use of pesticides i.e. 'Aman' paddy and 'rabi crops'.

V. Conclusion

Preventive measure can play huge role as all the unnatural deaths seemed avoidable. It is customary to emphasize the role of psychiatrist/psychologist in most of the background situations leading to death from poisoning. Premarital counselling is very much required for better understanding between the husband and wife to feel the needs and problems of each other. The needs of adolescents is another important area where the parents as well as the children must be routinely involved in counselling for avoiding family conflicts. People also requires counselling to win the stress arising out of crisis in life like unemployment, financial loss, bereavement of near and dear ones, pain and anguish due to chronic physical as well as mental illness. Ongoing counselling in different phases of life since childhood may be thought of for this purpose which requires a very strong policy framework. Strict legal enforcement is also one of the needs of the hour for careful selling, purchasing, use and storage of agrochemicals in rural areas. For this purpose certification from the Panchayat personnel may be made compulsory for purchasing pesticide each time. Awareness of the farmers should be increased by all means for proper handling of pesticides. Its storage is to be discouraged unless it is absolutely required.

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